

UPDATE R&D ON GANODERMA AND OTHER FIELD DISEASES IN OIL PALM

IDRIS A. S. (PhD)

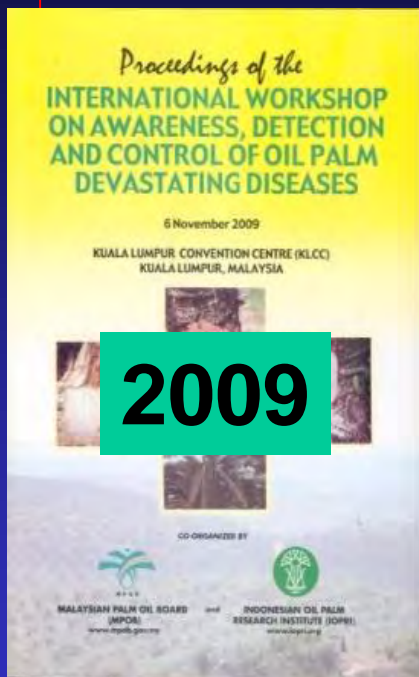
UNIT HEAD,

**GANODERMA AND DISEASES RESEARCH FOR OIL PALM
(GanoDROP), BIOLOGY DIVISION, MPOB,
BANDAR BARU BANGI, SELANGOR**

**SOPPOA WORKSHOP ON GOOD AGRICULTURE PRACTICES –
SARAWAK EXPERIENCES, BINTULU, SARAWAK,
6 AUGUST 2014, ORGANIZED BY SOPPOA.**

INTERNATIONAL SEMINAR ON OIL PALM PESTS AND DISEASES

Jointly organized by MPOB, Malaysia and IOPRI, Indonesia:



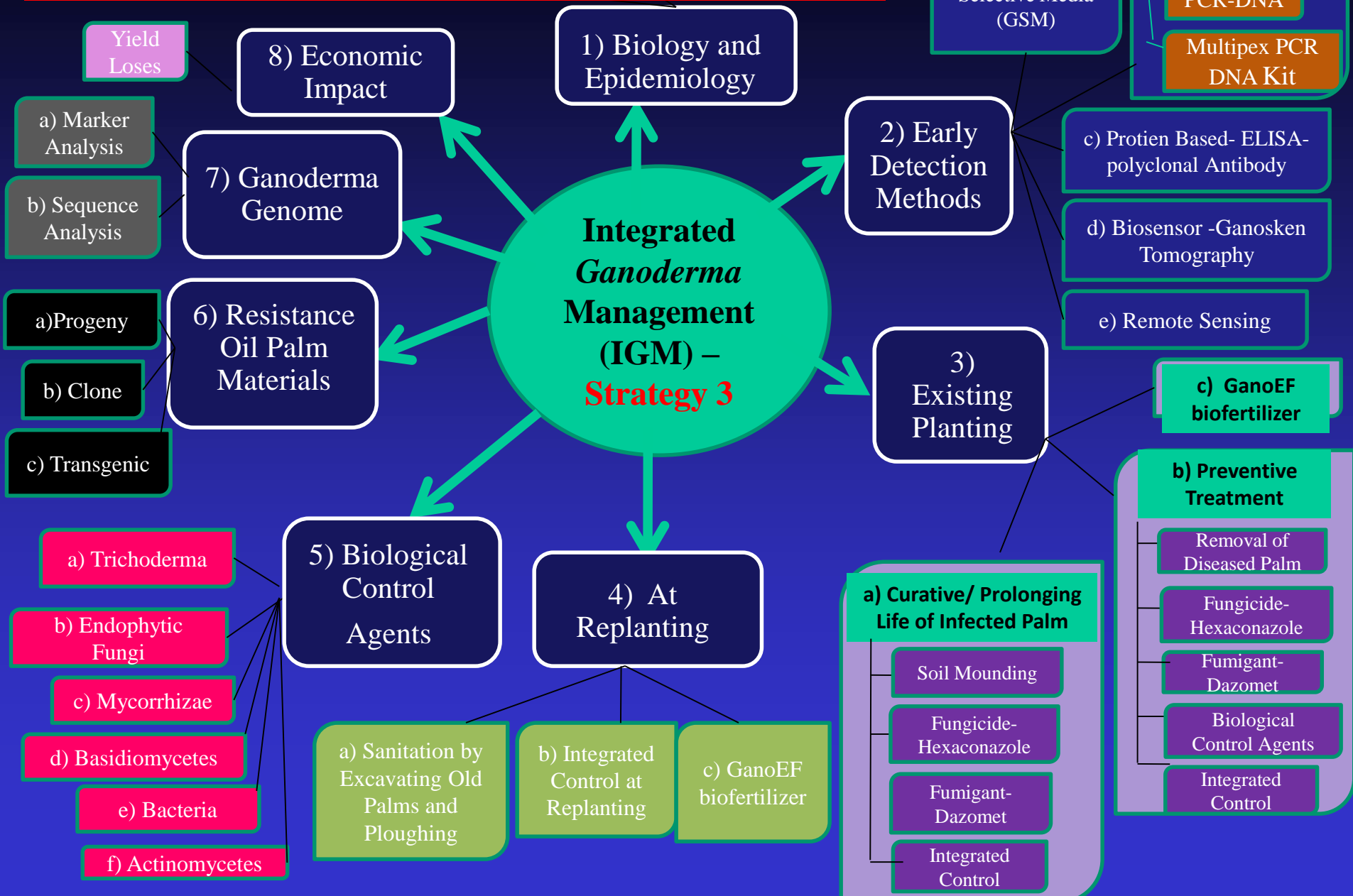
2013 - 5th MPOB-IOPRI Int. Seminar: Sustainable Management of Pests and Diseases in Oil Palm - The Way Forward. Insect Pests, Ganoderma & other diseases and Weeds.

OIL PALM DISEASES

- Devastating diseases (South-Central America, Africa and SouthEast Asia) :
 - Vascular wilt - *F. oxysporum* f. sp. *elaedis*
 - Red ring - *Bursaphelenchus cocophilus*
 - Sudden wilt - *Phytophthora staheli*
 - Bud rot - *Phytophthora palmivora*
 - *Lethal wilt*
 - **Basal stem rot (BSR) - *Ganoderma* spp.**
- Emerging diseases - Cercospora leaf spots, Phytoplasma, Spear rot and OS-CCCVd
- Other diseases (infecting seeds, nursery seedlings and field palms) are minor (very low incidence and under control).



GANODERMA RESEARCH PROGRAMMES AT MPOB



Biology and Epidemiology of *Ganoderma* Disease

- **Status of Ganoderma disease**
- **Pathogenicity tests**
- **Alternative hosts, e.g Leguminous cover crops**
- **Planting density**

- **Macro and micro-nutrients – e.g N,P,K and Cu, Fe, Silica, Mn**
- **Soil chemicals, e.g. pH**
- **Insect vectors**
- **Herbicides application**

INCIDENCE OF *GANODERMA* DISEASE IN MALAYSIA

1930 - Old palms, >25 years old.

1957 - Mature palms, 10-15 years old.

1990 - Immature palms, 1-2 years old.

1. BSR Census in 1994-1995 (PORIM/MPOB):

BSR disease palms – 1.51%.

No. of estates with BSR – 268.

Affected areas – 31,197 ha.

2. Sime-Darby Plantations – 1.44%

(Khairudin and Chong, 2008)

3. FELDA Plantations – 1.02%

(Noorhisham, 2010)

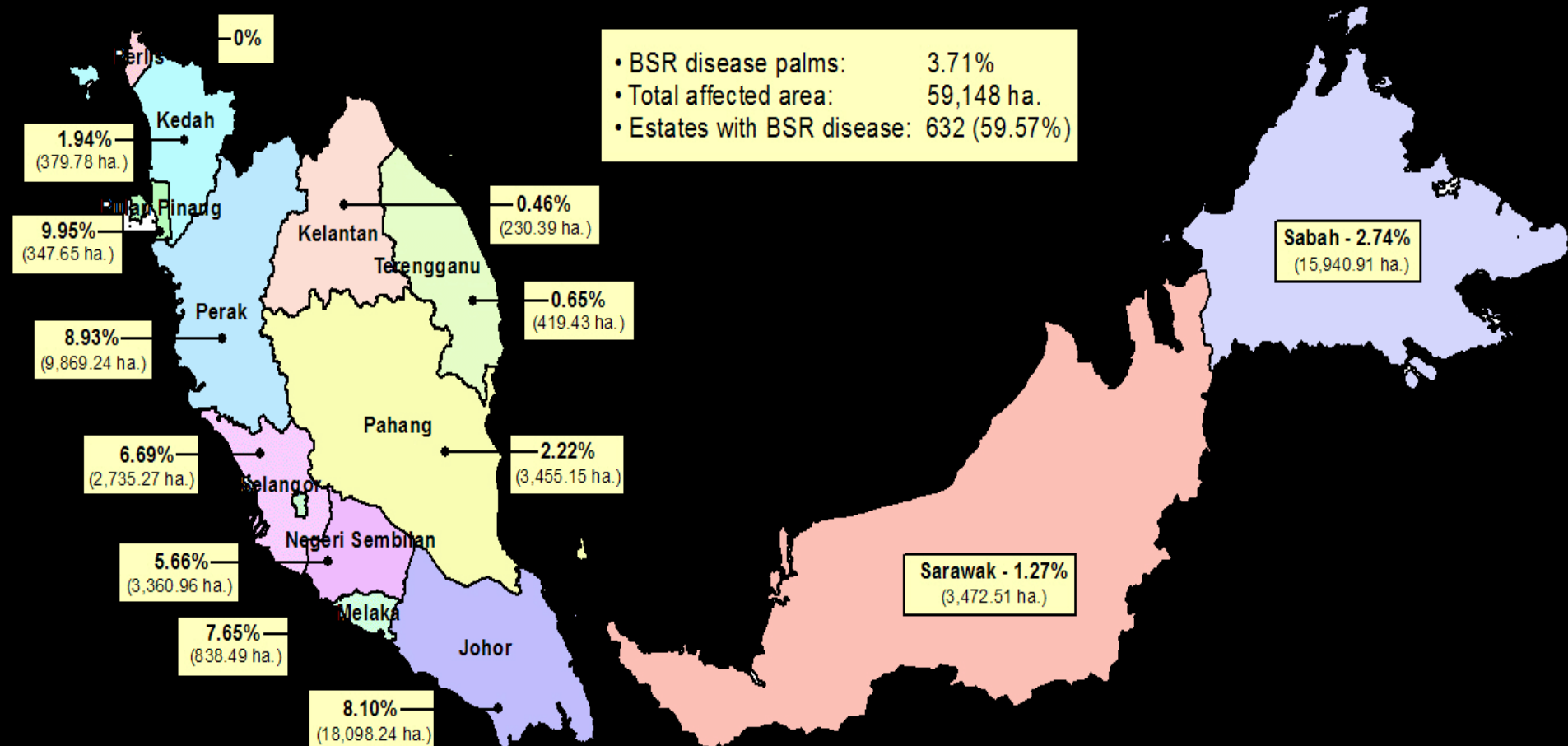




SURVEY OF GANODERMA DISEASE IN MALAYSIA (Idris et al., 2011; PIPOC)

Total no. of estates contacted: 2,355.
No. of estates responded: 1061 (45.0%).
Total areas responded: 1.594 million ha.

BSR disease palms: 3.71%
Total affected areas: 59,148 ha.
**Estimated losses: USD 0.569 billion
(RM 1.5 billion) (Arif et al., 2011).**



Sub-project 1.1: BSR survey in oil palm smallholders (>25 years old) – Skim Tanam Semula Sawit Pekebun Kecil (TSSPK)

Bancian Penyakit di Pekebun Kecil:

- ▶ Incidence of BSR disease palms was **8.0%, which involved 2,744.9 ha** (out of 34,067.9 ha), especially in Johor (801 ha), Sabah (740 ha), Perak (570 ha), Selangor (331 ha) and Sarawak (135 ha).
- ▶ Total no. of smallholders involved: 9,287.
No. of smallholders with BSR disease: 1,258.
% of smallholders with BSR disease: 13.55%.



**Ground BSR
census
(palm >25 years old)**

The Species of Ganoderma Fungus (Idris, 1999)

Species of <i>Ganoderma</i>	Pathogenicity test (infection in roots)
<i>G. boninense</i>	Pathogenic (most aggressive – 2.5 cm/month)
<i>G. zonatum</i>	Pathogenic (moderately – 1.9 cm/month)
<i>G. miniatocinctum</i>	Pathogenic (least aggressive – 1.5 cm/month)
<i>G. tornatum</i>	Non-pathogenic (saprophytic)



G. boninense



G. zonatum



G. miniatocinctum



G. tornatum

GANODERMA ON LEGUMES



- Legumes could be inoculated with *Ganoderma*. Mycelium and basidiomata of *Ganoderma* was detected.
- The most tolerant was *Mucuna bracteata* while *Calopogonium mucunoides* was the most susceptible.
- Infected legumes significantly reduced the formation of nodules.
- Legumes act as 'alternative host' for *Ganoderma* to survive.

► Results presented at the PIPOC, 2007
KLCC, KL.

Studies on Planting Density In Relation to *Ganoderma* Disease (Idris et al., 2013)

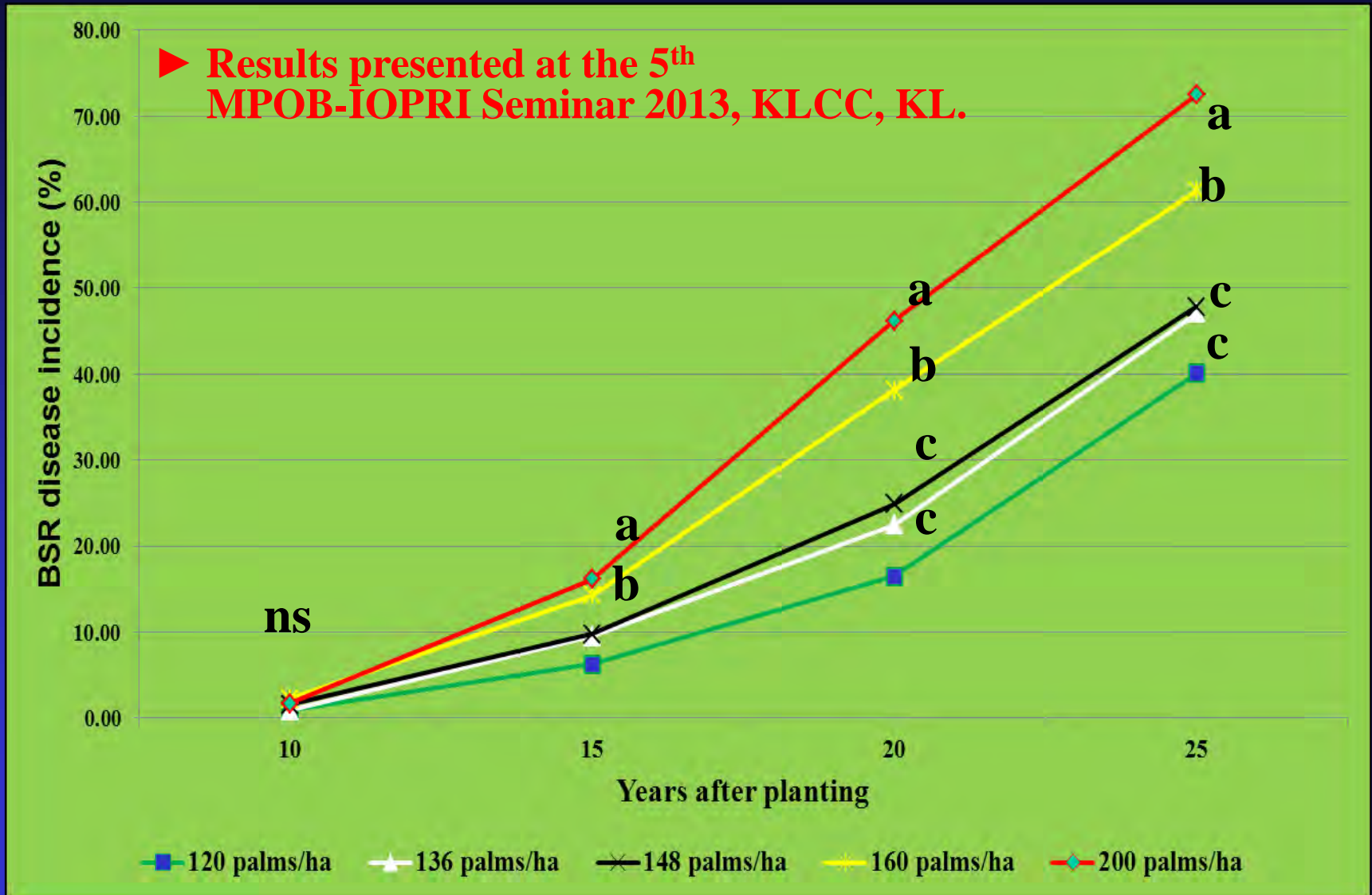


- ✓ Study site: Teluk Intan, Perak
- ✓ Oil palm generation: 1st
- ✓ Soil type: Peat soil
- ✓ Previous crop: Ex-jungle
- ✓ Field planted: 1986



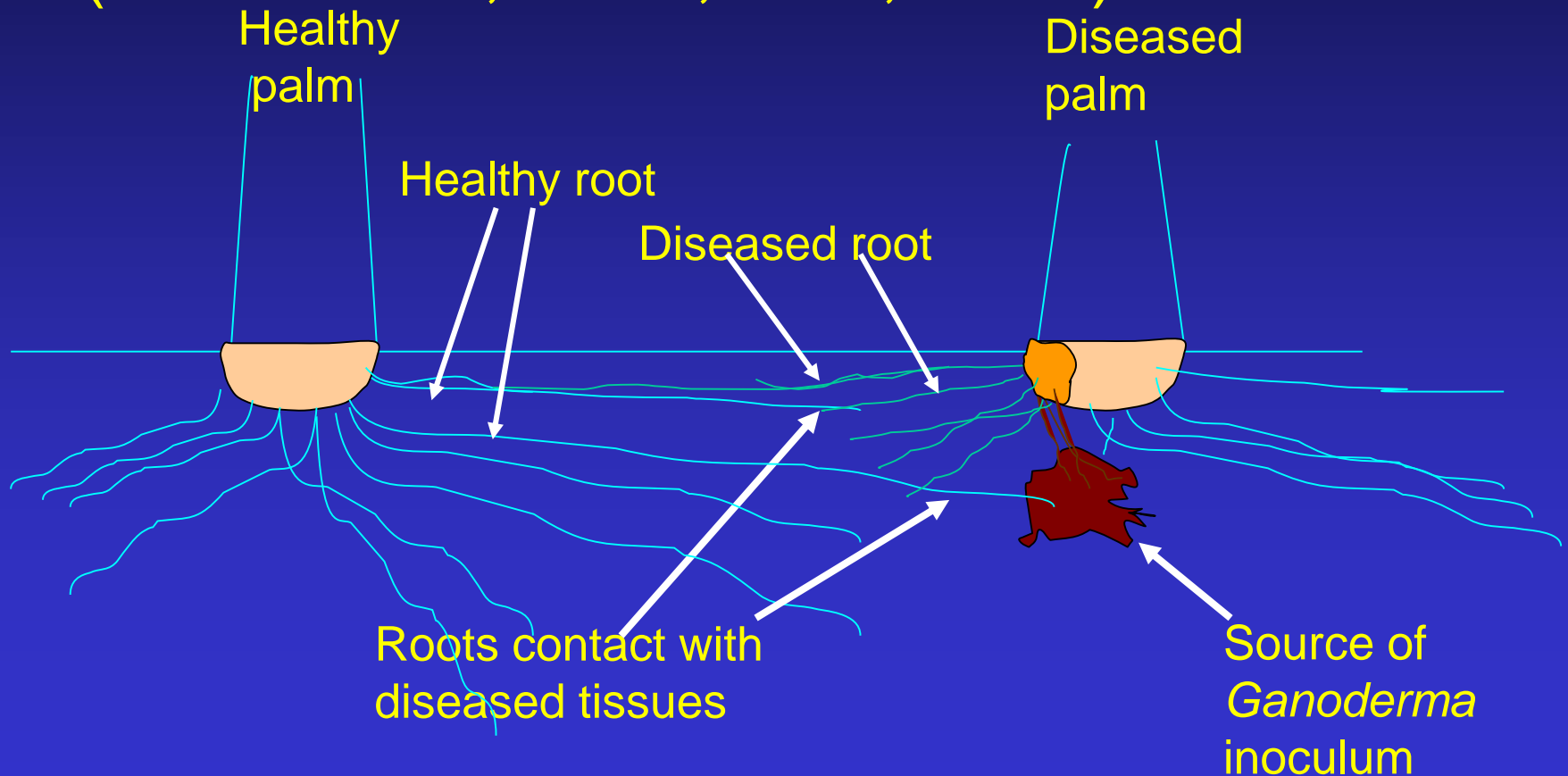
- ✓ **Planting density (palms/ha):**
 - i. 120 (Low)
 - ii. 136 (Moderate)
 - iii. 148 (Moderate)
 - iv. 160 (High)
 - v. 200 (High)

Results – BSR disease incidence (%) – 10, 15, 20 and 25 years after planting



Epidemiology (disease spread)

1. Mycelium contact - Contact between healthy roots with diseased tissues left buried in soil (Flood et al., 2000; Idris, 2011)



Epidemiology (disease spread)

2. Basidiospores – play a role in spreading the disease, through insects vector (Idris, 2011).



Episcapha 4-maculata

can carry basidiospores of *Ganoderma* and infect oil palm



Upper Stem Rot (USR) disease caused by *Ganoderma* sp.



DETECTION OF *GANODERMA*

- ✓ **Visual (external and internal) symptoms**
- ✓ **Early detection**

Field Detection of Ganoderma

1. Visual (external and internal) symptoms e.g: foliar symptoms, rotted roots and stem/trunk.

**Disease symptoms
– immature palm**



**Disease symptoms
– mature palm**



Confirmation of disease (Field Diagnosis)

Fruiting body of Ganoderma (Basidiomata)

- develop as a small white buttons; then bracket-shaped (mature) which vary in shape, size and colour
- Fungus *Ganoderma* can be cultured



Early Detection of *Ganoderma*

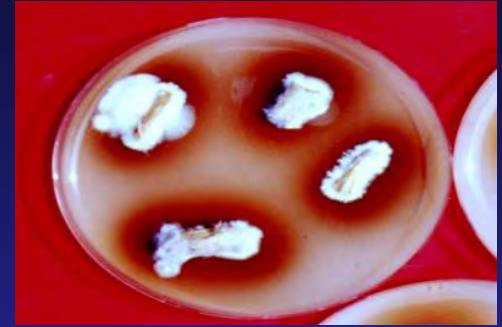


No External BSR Symptoms

- No foliar symptoms
- No fruiting body

Early Detection of *Ganoderma*

1. **Culture based – Ganoderma Selective Medium (GSM), (Ariffin and Idris, 1992)**
2. **Molecular DNA-based**
 - i. **PCR technique for detection of *Ganoderma* (Idris et al., TOT, 2003)**
 - ii. **Multiplex PCR-DNA Kit for detection and identification of *Ganoderma* species in oil palm (Idris et al., TOS, No. 73, 2010)**
3. **Immunoassay Protein-based – ELISA- polyclonal antibody for detection of *Ganoderma* (Idris et al., TOT, 2008)**



Early Detection of *Ganoderma*

4. **Biosensor-based - GanoSken tomography for early detection of *Ganoderma* infection in oil palm (Idris et al., TOT, No. 442, 2010).**



5. **Volatile Organic Compounds (VOC) - Determination of *Ganoderma* Volatile Organic Compounds in Oil Palm. MPOB Information Series No. 642 (MPOB TS No. 120, 2013).**

6. **Remote Sensing (Aerial detection) - Field spectroscopy for detection of *Ganoderma* disease in oil palm. MPOB Information Series No. 630 (MPOB TT No. 532, 2013).**



CONTROL AND MANAGEMENT OF *GANODERMA* DISEASE

- 1. In existing plantings**
- 2. At replanting**
- 3. Products as Preventive Treatment**
(biological control and organic chemical fertilizer)
 - to prolong the productive life of the infected palms.**
 - to eradicate the *Ganoderma* inoculum.**
 - to minimize the inoculum burden carried over in the subsequent planting.**

DISEASE CONTROL AND MANAGEMENT IN EXISTING PLANTINGS

PREVENTIVE CONTROL :

- 1. Sanitation by removal (deboling) of diseased palm (Idris et al; TOT, 2005)**
- 2. Stump treatment with fumigant dazomet (Idris and Maizatul, TOS, 2012)**

Curative Control/ Prolonging the productive life of the *Ganoderma*-infected palms:

- 1. Fungicide hexaconazole (trunk injection) (Idris et al., 2004)**
- 2. Soil mounding (Tuck and Khairudin, 1997)**

Control of *Ganoderma* in Existing Planting

**i). Removal (deboling) of
diseased palm using
excavator/backhoe**

**(Idris et al., 2004: MPOB TT
NO. 260).**

Size: 2m x 2m x 1.5m



Effect of supply palms planted at the diseased stump not excavated (deboling) in existing planting (Idris et al., 2004)

Palm planted at the diseased stump not excavated	Supply palms infected (%)		
	3 years	6 years	9 years
1. Johor 1 (n=250)	23.3	63.3	83.3
2. Johor 2 (n=500)	10.5	26.0	60.5
3. Selangor (n=750)	5.5	30.5	65.0



ii) Stump Treatment With Dazomet for Controlling *Ganoderma* Disease in Oil Palm

(Idris and Maizatul, TOS, 2012)

- ✓ Fumigant such as dazomet (methylisothiocyanate (MITC)), is one means of reducing inoculum of some root rotting fungi.
- ✓ Field study to evaluate the effect of dazomet (MITC) to eradicate *Ganoderma* inoculum in the infected stump was investigated.



An infected stump with *Ganoderma* fructification



Dazomet powder

Field Evaluation of Stump Treatment With Dazomet For Eradication of *Ganoderma* Inoculum

- ✓ At 3 years, *Ganoderma* fungus survived in the untreated infected stumps (control) .
- ✓ *Ganoderma* fungus significantly eradicated (60% - 83.6%) when infected stumps treated with dazomet at 250, 500 and 750 g/stump.
- ✓ Dazomet moved into the stump and caused death to the *Ganoderma* fungus.
- ✓ Rate/stump – 500 g.



Benefits

- ✓ Dazomet has potential to eradicate *Ganoderma* inoculum within the infected stump, therefore reducing the spread of *Ganoderma* disease within the oil palm plantation.

2. *Ganoderma*-infected palm WITH NO FOLIAR SYMPTOMS (productive)

- **Soil mounding**
- **Fungicides -
hexaconazole
(e.g. ANVIL^R)**



FUNGICIDE HEXACONAZOLE – Prolonging of the productive *life of Ganoderma*-infected palms



**Trunk injection
with hand-knock
injector**

- Completed studied:
 - i. Segamat, Johor (Inland soil)
 - ii. Sepang, Selangor (coastal soil)
 - iii. Teluk Intan, Perak (Peat soil).
- Diseased palms treated with hexaconazole (**4.5 g a.i + 7 L water**) using hand-knock injector significantly lower dead palms compared to untreated.
- Results - 66.6% – 83.3% (**average 74.4%**, 3 trials) of treated infected palms with hexaconazole still alive and producing fruit bunches at **5 years** and none from untreated palms.

Soil mounding

Soil obtained from the inter-rows using a backhoe, 1M height and 2M in diameter



- prolonging the *Ganoderma*-infected oil palm through the physical benefit of preventing the weakened boles from toppling by wind.

Control and Management of Ganoderma at Replanting

1. Do Not Under-planting - high BSR incidence in replanted palms



Incidence of BSR disease in replanted palms after adopting underplanting oil palm with oil palm, 16-18 years after planting (2nd generation) (Idris, 2012)

Plantation group	BSR disease (%)
Estet 1-Batu Pahat (36.8 ha)	47.5
Estet 2-Kluang (45.6 ha)	42.0
Estet 3-Segamat (29 ha)	33.4
Estet 4-Sepang (39.2 ha)	57.5
Estet 5-Kuala Selangor (23 ha)	32.8
Estet 6-Teluk Intan (32 ha)	31.8
Estet 7-Sg. Krian (18.5 ha)	49.3
Estet 8-Seberang Prai (27 ha)	31.7

Strategies to control BSR disease At Replanting:

1. Sanitation by removal (deboling) of boles, stumps and root masses, ploughing and planting new palm along the ploughing areas (Idris et al., TOT, 2004)

Two Study Sites:

Site 1: Sepang, Selangor

Soil type : Selangor series (coastal)

Study started : 1992

BSR incidence (1st generation): T1 (39.9%) and T2 (43.4%)

Planting density (1st generation): 136 palms/ha
(2nd generation): 148 palms/ha

Site 2: Segamat, Johor

Soil type : Durian series (Inland)

Study started : 1993

BSR incidence (1st generation): T1 (35.4%) and T2 (36.8%)

Planting density (1st generation): 148 palms/ha
(2nd generation): 160 palms/ha



Mean incidence of BSR disease on replanted palms, 15 years after planting

Treatment	BSR incidence on replanted palms (%)		
	Selangor	Johor	Average (%)
T1 - without sanitation (estate practices including pushing the old stands, shredding, and stacking)	29.0	49.8	39.4
T2 - sanitation (estate practices + excavating soil, stumps and root masses; ploughing and planting new palms along ploughing areas)	6.5	10.6	8.5
Disease control (%)	22.5	39.2	30.8



Deboling at Replanting Areas



Ploughing at Replanting Areas



Chipping trunk and root masses at Replanting Areas



Adoption of Disease Control and Management Technologies At Replanting – Surveyed 2009-2010

Sanitation by removal (deboling) of bole, stump and root masses of old palm stands



	No. of estates involved	Area involved (ha.)	Average cost (RM/palm)
Partially sanitation	159	11,301.4	13.06
Completely sanitation	131	40,359.5	11.28
	290	51,660.9	

Monitoring Effects of Spatially Sanitation at replanting on Ganoderma Disease by Oil Palm Plantations

BSR disease incidence, 3 years after planting:

- 1. Estet 1 (75 ha, Johor) – 5%.**
- 2. Estet 2 (84 ha, Perak) – 3%.**
- 3. Estet 3 (160 ha, Selangor) – 3.5%.**
- 4. Estet 4 (65 ha, Johor) – 2.8%.**
- 5. Estet 5 (38 ha, Pahang) – 0%.**
- 6. Estet 6 (43 ha, Pahang) – 0%.**
- 7. Estet 7 (67 ha, Terengganu) – 0%.**



Commercial Products As Preventive treatments



1. GanoEF biofertilizer



2. EMBIO™ actinoPLUS



3. GanoCare™



1. GanoEF biofertilizer

(Commercial product)

Product launching on 14th June 2012, MPOB, Malaysia

Jointly developed

by MPOB and

All Cosmos Industries

Sdn. Bhd., Pasir Gudang,

Johor, Malaysia

Tel: +607 – 252 3788

Fax: +607 – 251 2588

Website: www.allcosmos.com

(Idris et al., TOT; 2012)

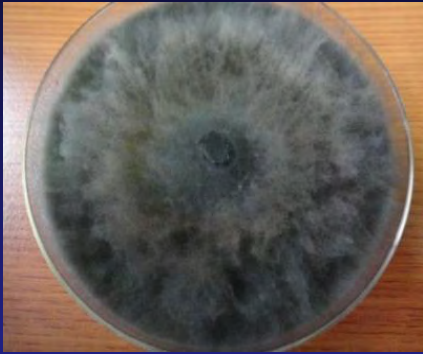


4 IN 1

GanoEF
Biofertilizer

GanoEF Biofertilizer

Biological Control of Ganoderma Disease



✓ Incorporated *Hendersonia* GanoEF1 (endophytic fungus) into organic and inorganic fertilizer.

✓ It is a formula for *Ganoderma* prevention, soil fertility and vegetative growth.

Awards

24th International
Invention, Innovation and
Technology Exhibition
(ITEX) 2013 (2 medals)
Gold medal for ITEX
Award, and Malaysia
Innovative Product Award.

✓ The product has significantly reduced (70%) the *Ganoderma* infection in oil palm (nursery evaluation).



4 IN 1

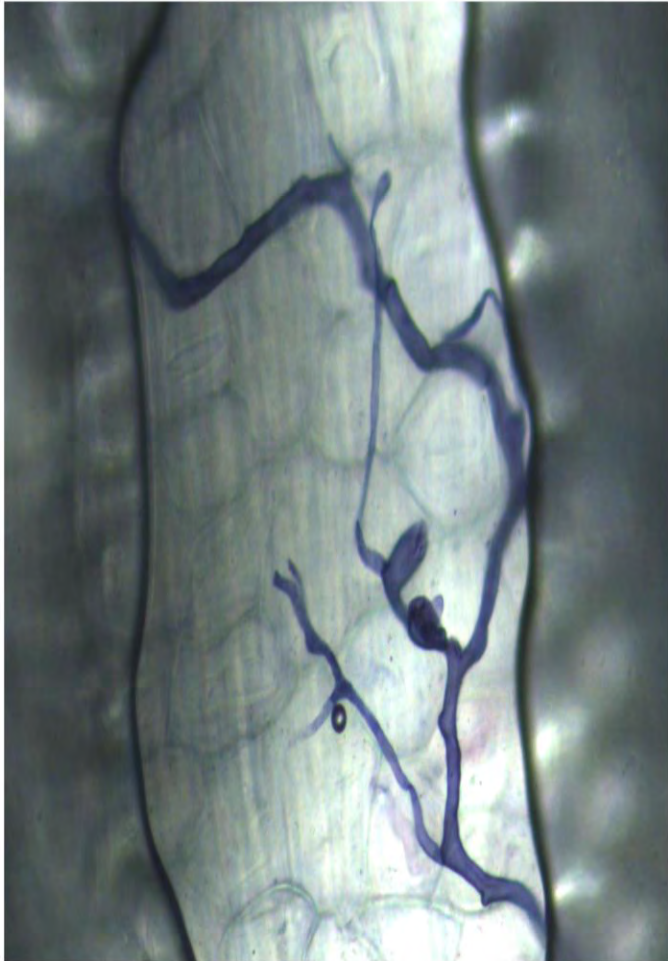
GanoEF
Biofertilizer

Endophytic fungus: *Hendersonia GanoEF1*



Colonization in mainly in the primary and secondary roots and other roots of oil palm (40 – 88%).

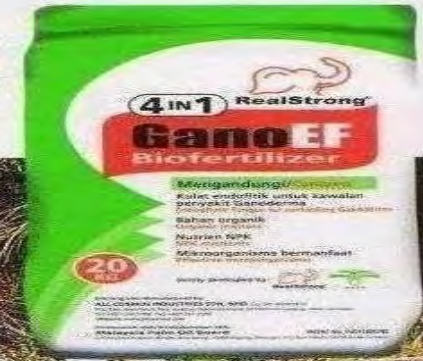
Oil palm roots increased the levels of active compound / enzyme activities: lignin and chitinase, glucanase, peroxidase (PO) and phenylalanine ammonia lyase (PAL)
- which are known to be physical barrier to *Ganoderma* infection.



4 IN 1

GanoEF
Biofertilizer

GanoEF, a 4 in 1 biofertilizer
jointly developed by MPOB
and All Cosmos Industries



THE PLANTER



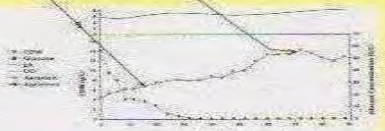
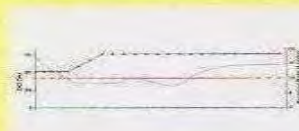
Proven to control the spread of Ganoderma disease

MPOB is assisting to apply patent for GanoEF biofertilizer

* *Hendersonia* species is identified by CABI, UK

Developed to prevent basal stem rot in oil palm caused by the *Ganoderma* fungus, GanoEF is a combination of *Hendersonia* (an endophytic fungus), effective nutrients, organic matters and beneficial microorganisms.

Hendersonia used in the composition for controlling *Ganoderma* stem rot is being patented. With GanoEF, the incidence of infection by *Ganoderma* disease has been proven to have reduced by up to 70%.



Jointly-developed with MPOB



For more information contact: 607 - 252 3788 Email: sales_marketing@allcosmos.com



Manufactured by:
ALL COSMOS INDUSTRIES SDN. BHD. Co. No. 487874-D
P.L.O 539, Jalan Keluli, Pasir Gudang Industrial Estate, 81700 Pasir Gudang,
Johor, Malaysia. Tel: +607-252 3788 Fax: +607-251 2588
Website: www.allcosmos.com



YouTube: www.youtube.com/theactix
Facebook: www.facebook.com/allcosmos

2. EMBIO actinoPLUS

(Commercial product)

Product launching on 18th June 2014, MPOB, Malaysia

Jointly developed

by MPOB and

Pascal Biotech Sdn. Bhd.,

Shah Alam, Selangor,

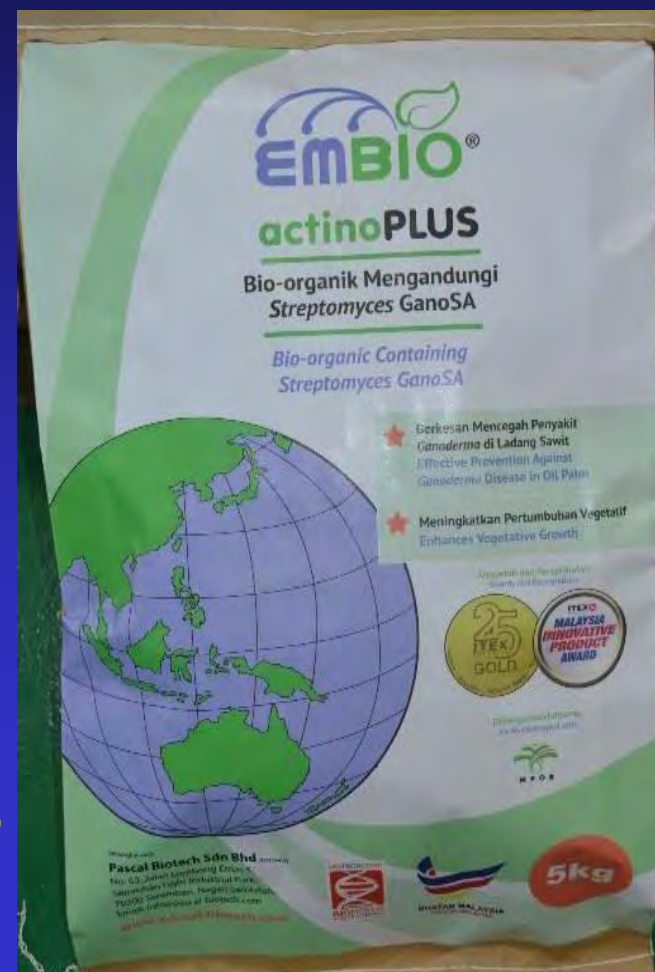
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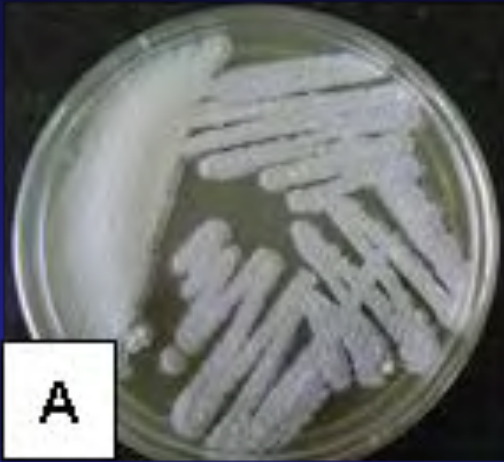
Email: info@pascal-biotech.com

Website: www.pascal-biotech.com



EMBIO actinoPLUS

Biological Control of Ganoderma Disease



✓ Incorporated *Streptomyces* GanoSA1 (soil actinomycete) into organic fertilizer.

✓ It is a formula for *Ganoderma* prevention, soil fertility and vegetative growth.

Award

○ MPOB Anugerah Inovasi 2013.

○ 25th International Invention, Innovation and Technology Exhibition (ITEX) 2014 (2 medals): Gold medal for ITEX Award, and Best Malaysia Innovative Product Award.

✓ The product has significantly reduced (65.2%) the *Ganoderma* infection in oil palm (nursery evaluation).

1. Nursery testing – effects of EMBIO™ actinoPLUS on the vegetative growth of oil palm seedlings

- Two treatments were evaluated with 30 seedlings per treatment.
- Seedling treated with actinoPLUS applied monthly interval (9 applications, 50 g/seedling/application; at 4 to 12 months old seedling).
- After 9 months of application, significant different between untreated and treated seedlings were recorded, for total no. of fronds production, seedling height and leaf areas.



Treatment	*Total no. of fronds	*Height (cm)	*Chlorophyll (Chl, SPAD)	*Leaf area (m ²)
Untreated seedlings (control)	13 b	132.8 b	50.2 a	1.277 b
Seedlings treated with actinoPLUS	15 a	147.3 a	57.2 a	1.391 a



2. Nursery testing – effects of EMBIO™ actinoPLUS in controlling *Ganoderma* disease in oil palm seedlings

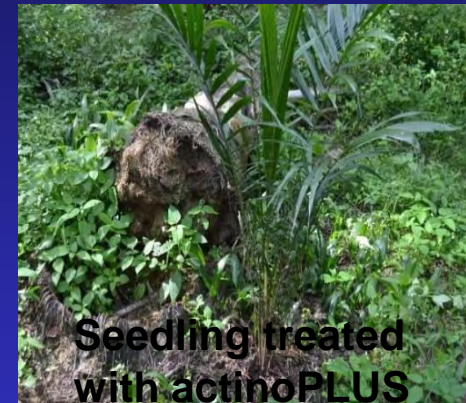
- Two treatments were evaluated with 30 seedlings per treatment.
- Seedling treated with actinoPLUS applied 4 times (at 3, 4, 7 and 10 month old, 50 g/seedling/application).
- Seedling was inoculated with *G. boninense* using rubber wood block (RWB) sitting technique.
- After 8 months of inoculation, seedlings treated with actinoPLUS significantly lower disease incidence and dead due to *Ganoderma* infection. BSR disease was reduced 65.2% in seedlings treated with actinoPLUS.

Treatment	Disease incidence (%)	Dead seedlings (%)	Disease reduction (%)
Untreated seedlings and inoculated with <i>G. boninense</i> (control)	93.3 a	73.3 a	65.2
Seedlings treated with actinoPLUS and inoculated with <i>G. boninense</i>	50.0 b	43.3 b	



3. Field testing – effects of EMBIO™ actinoPLUS in controlling *Ganoderma* disease in field planted oil palm

- Two treatments were evaluated with 30 seedlings per treatment.
- Seedling treated with actinoPLUS applied 4 times (at 4, 7 and 10 month old, at 50 g/seedling/application; and in planting hole, at 250 g/hole)).
- Twelve-month old seedlings were planted 35 cm away from *Ganoderma*-infected stump.
- After 30 months of planting, no symptom of BSR disease and dead palm was observed on seedling treated with actinoPLUS. About 23.3% of the untreated seedlings were dead due to *Ganoderma* infection.



Treatment	Dead seedlings (%)
Untreated seedlings (control)	23.3
Seedlings treated with actinoPLUS	0

3. GanoCare™

(Commercial product)

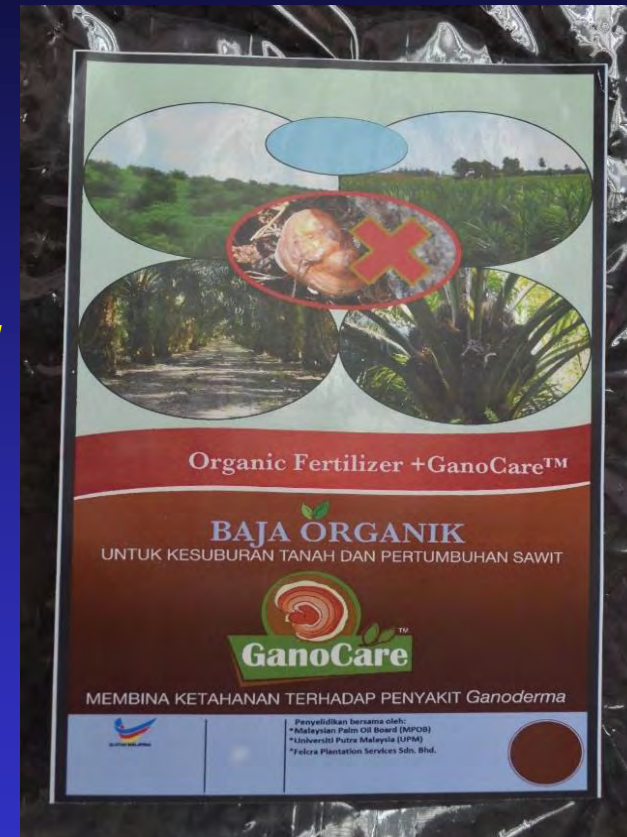
*Jointly developed
by MPOB, UPM and FELCRA:
FELCRA Plantation Services Sdn Bhd.,
Wisma FELCRA, Jalan Rejang,
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53300 Kuala Lumpur*

Tel: +603 – 4142 6000

Fax: +603 – 4142 5020

Email: administrator@fpssb.com.my

Website: [www.felcra_plantation_services_sdn_bhd](http://www.felcra_plantation_services_sdn_bhd.com)



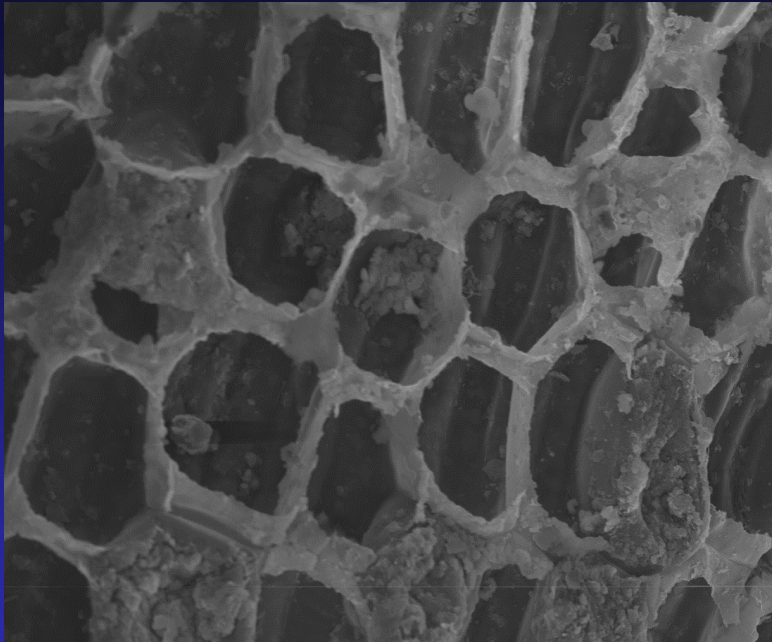
1. Nursery testing – effects of GanoCare™ on the vegetative growth of oil palm seedlings

- Three treatments (T1, T2 and T3) were evaluated with 45 seedlings per treatment.
- Treatments: T1-untreated seedling (control); T2- seedlings treated with GanoCare™ applied monthly interval (9 applications); and T3- seedlings treated with GanoCare™ applied 3-monthly interval (3 applications).
- After 9 months of application, significantly different between untreated (T1) and treated seedlings (T2) were recorded, for total no. of fronds production, girth, seedling height, rachis length, total dry weight and leaf areas.

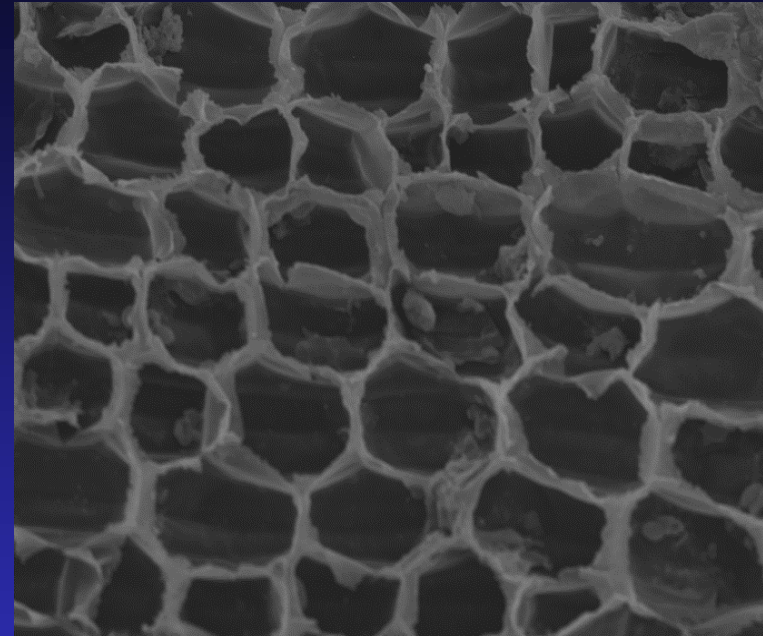


Treatment	*Total no. of fronds	*Height (cm)	Rachis length (cm)	Girth (mm)	Total dry weight (g)	*Chlorophyll (Chl, SPAD)	*Leaf area (m ²)
T1- Untreated seedlings	14 c	149.7 b	74.8 b	80.1 c	250 c	57.7 a	1.277 b
T2-Seedlings treated with GanoCare™ applied monthly interval (9X)	16 a	160.3 a	84.9 a	89.5 a	300 a	59.8 a	1.391 a
T3-Seedlings treated with GanoCare™ applied 3-monthly interval (3X)	15 b	150.1 b	75.4 b	87.7 b	280 b	58.1 a	0.944 c

1. Nursery testing – effects of GanoCare™ on the vegetative growth of oil palm seedlings



2a – cell wall of root of seedling treated with GanoCare™ - thicker.



2b – cell wall of root of untreated seedling

Scanning electron microscopy (magnification 450x) showing section of oil palm root. Cell wall of root (2a) of seedling treated with GanoCare™ has thicker compared with root of untreated seedling (2b).

2. Nursery testing – effects of GanoCare™ in controlling *Ganoderma* disease in oil palm seedlings

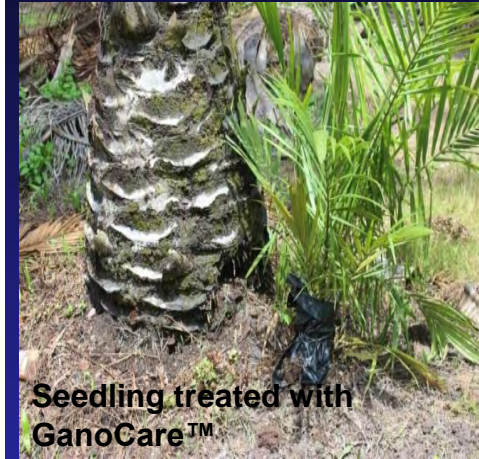
- Two treatments were evaluated with 30 seedlings per treatment.
- Seedling treated with GanoCare™ applied at monthly intervals (9 times, total 450 g/seedling).
- Seedling was inoculated with *G. boninense* using rubber wood block (RWB) sitting technique.
- After 8 months of inoculation, seedlings treated with GanoCare™ significantly lower disease incidence and dead due to *Ganoderma* infection. BSR disease was reduced 63.5% in seedlings treated with GanoCare™.

Treatment	Disease incidence (%)	Dead seedlings (%)	Disease reduction (%)
Untreated seedlings and inoculated with <i>G. boninense</i> (control)	90.0 a	86.7 a	63.5
Seedlings treated with GanoCare™ and inoculated with <i>G. boninense</i>	43.3 b	40.0 b	



3. Field testing – effects of GanoCare™ in controlling *Ganoderma* disease in field planted oil palm

- Two treatments were evaluated with 30 seedlings per treatment.
- Seedling treated with GanoCare™ applied 10 times (9 times in nursery, at 50 g/seedling/application; and one month after planting in the field, at 500 g/palm).
- Twelve-month old seedlings were planted 35 cm away from *Ganoderma*-infected stump.
- After 30 months of planting, no symptom of BSR disease and dead palm was observed on seedling treated with actinoPLUS. About 23.3% of the untreated seedlings were dead due to *Ganoderma* infection.



Treatment	Dead seedlings (%)
Untreated seedlings (control)	23.3
Seedlings treated with GanoCare™	0

NURSERY APPLICATION – seedlings

Rate:

GanoEF **150 g (3X)**

actinoPLUS **150 g (3X)**

GanoCare **450 g (9X)**



FIELD APPLICATION – Planting hole (at replanting or in existing planting)



Rate:

GanoEF **500 g/hole**

actinoPLUS **250 g/hole**



GanoCare **500 g/palm**
(one month after planting)

FIELD APPLICATION – in existing plantings



Immature/Young palm:

Rate (kg/palm/year):

GanoEF 2 kg (1X; subsoil)

actinoPLUS 300 g (1X; subsoil)

GanoCare 4.8 - 8.1 kg (3X)



Mature palm:

Rate (kg/palm/year):

GanoEF 4 kg (1X; subsoil)

actinoPLUS 600 g (1X; subsoil)

GanoCare 9.0 kg (3X)

Minor diseases - Field

1. **Stem wet rot (SWR)**
2. **Charcoal base rot (CBR)**
3. **Marasmius bunch rot**
4. **Sooty moulds**
5. **Algae leaf spot**
6. **Orange spotting - Coconut Cadang Cadang Viroid (OS-CCCVd) variants**

Minor field diseases

Stem wet rot

Pathogen - unknown (bacteria..?)

Symptoms - 1. death of all unexpanded spear leaves

2. dull yellowing discoloration of fronds

3. internal stem tissues - wet, stem rot is brown or yellow; and many fibrous mass.

**Stem completely rotted
(wet, brown/yellowing colour with fibrous mass)**



Cross section



Longitudinal section

Minor field diseases

Charcoal base rot

Pathogen - *Thielaviopsis* sp.

Symptoms - 1. one sided-yellowing
2. internal stem tissues-rotting
and produce charcoal-like

Rotted stump tissues - black and dry rot (charcoal-like symptom)



Minor field diseases

Marasmius bunch rot

Pathogen - *Marasmius palmivorus*

- Symptoms -
1. Fungus mycelium - white on the fruit surface
 2. Mesocarp - wet rot and light brown

Marasmius bunch rot (White mycelium on the fruit surface)



Minor field diseases

Sooty moulds

Pathogen - *Meliola elaeidis* (Africa)

Brooksia tropicalis (Africa, Malaysia, PNG)

Ceramothyrium sp. (Malaysia)

Symptoms - 1. Fungus mycelium - black and woolly areas

2. Mould forms discrete and circular lesions on upper pinna surface

**Fungus mycelium (black and wooly)
appears on the upper pinnae surface**



Not serious infection

Serious infection

Minor field diseases

Algae leaf spot

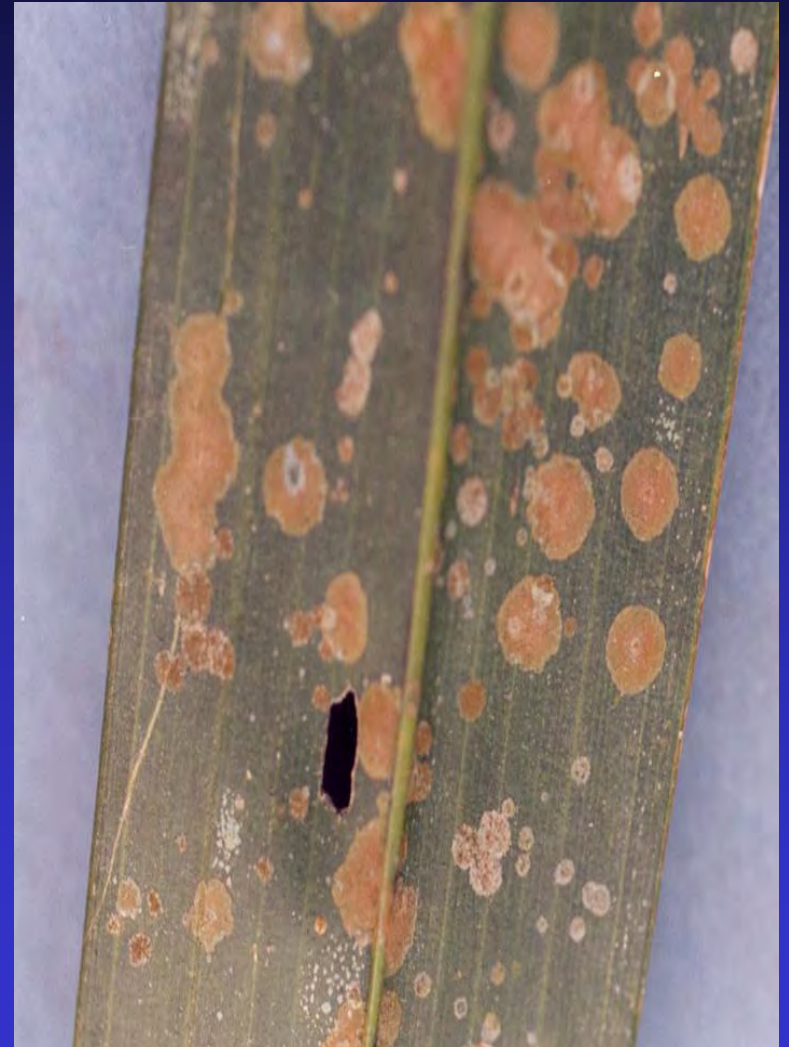
Pathogen - *Cephaleuros virescens* (Africa, Malaysia, PNG)

Phycopeltis sp. (Honduras, Malaysia)

Trentepohlia sp. (Malaysia)

Symptom - Produce small spots of reddish-brown colonies on the upper pinna surface or rachis

Colonies of algae on a pinnae (reddish-brown spots)



Orange spotting (OS) of oil palm

- recognised as a disorder in early 19th century, West Africa
- found in commercial plantations in South East Asia, the South Pacific, Central and South America
- It was first documented in Malaysia about 30 years ago
- CCCVd variant was confirmed to be present in all the three regions based on the screening by UPM (G. Vadamalai, 2010 & 2011)

Symptoms and Effects Caused by Orange Spotting (OS)

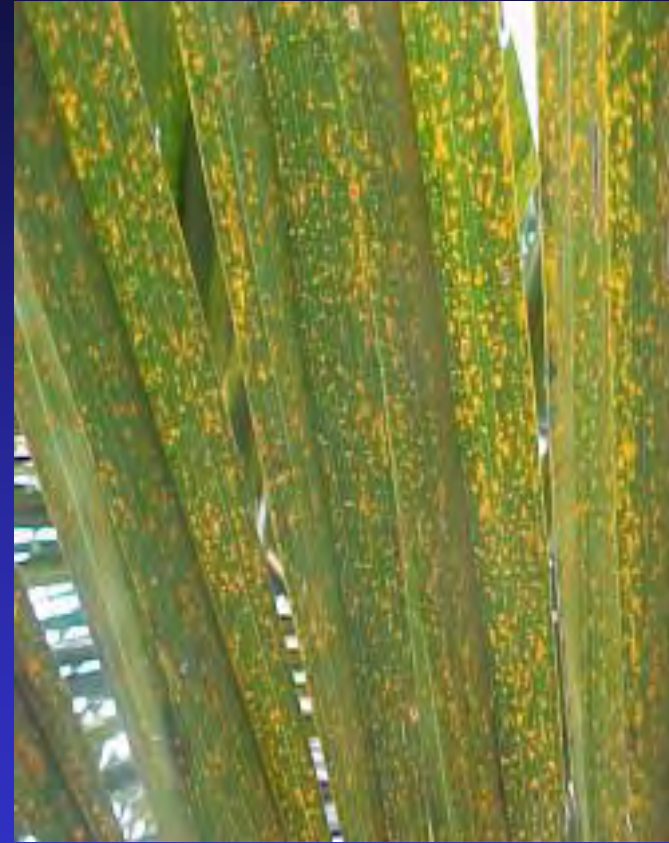
- Non-necrotic orange spots on leaflets
- Growth stunting
- Smaller fruit bunches or no fruit bunch
- Associated with losses in oil palm production
- Yield reduction up to 50% in a single palm compared to healthy adjacent palm

(Forde & Leyritz, 1968; Hanold & Randles, 1991; Randles, 1998)

Symptoms of Orange spotting (OS)



Healthy fronds



Fronds covered with orange/yellow leaf spots

Vadamalai, G. (2009)

Symptoms of Orange spotting (OS) cont...



Leaf spots appears as translucent orange/yellow in transmitted light



Leaf spots become numerous



Leaf spots become confluent
Frond turns yellow/bronze-coloured

Vadamalai, G. (2009)

Orange Spotting (OS) in Oil Palm

- Associated with potassium deficiency

(Hale, 1947; Coulter & Rosenquist, 1955)

- Possible to be of genetic origin ~ Genetic Orange Spotting (GOS)

(Forde & Leyritz, 1968)

viroid infection

- *Coconut cadang-cadang viroid (CCCVd)* ~ causal pathogen of Coconut cadang-cadang disease in coconut in the Philippines

(Hanold & Randles, 1991)



Picture showing severe OS with the oil palm crown discolored to bronze appearance

- **HOWEVER NOT ALL OS IS CAUSED BY CCCVd**

CONCLUSIONS

- **Among oil palm diseases in Malaysia, BSR disease is the most widely studied and knowledge available.**
- **The Ganoderma disease pose a major threat to oil palm industry in the near future, if no control measures is implemented.**
- **MPOB has transferred 32 technologies on Ganoderma disease: Biology and epidemiology, Early detection, Control and management in existing planting and at replanting.**
- **Some prevention and curative treatments developed are being adopter and implemented by oil palm industry and smallholders.**

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Thank You

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